GIS Based Site and Structure Selection Model for Ground Water Recharge

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Abstract — This study uses GIS to find the best places and structures for improving groundwater recharge. By analysing key factors like soil, slope, land use, rainfall, and drainage patterns, the model identifies areas where recharge would be most effective. It then suggests suitable structures—such as check dams, percolation tanks, or recharge pits—based on the conditions in each location. The approach makes groundwater planning easier, more accurate, and more practical for managing water resources sustainably.

Keywords: GIS, Groundwater Recharge, Site Selection, Structure Selection, AHP, Recharge Zones, Check Dams, Percolation Tanks, Hydrological modelling, Watershed Management, Sustainable Water Resources. Google earth pro, QGIS, TCX Convertor

I. Introduction

Groundwater is a crucial natural resource that supports agricultural, domestic, and industrial activities, especially in regions facing increasing water scarcity. A GIS-based approach offers a scientific method for selecting suitable sites and structures for groundwater recharge. Using software such as ArcGIS or QGIS, various thematic layers—including soil, geology, land use, and lineaments—can be integrated to identify potential recharge zones. Contour maps generated from DEM data help analyze terrain features, slope, and runoff patterns, which are essential for locating effective recharge structures like check dams or percolation tanks. This combination of GIS tools and contour mapping provides accurate, efficient, and data-driven support for sustainable groundwater management.

II. Literature review:

- Smith et al. (2020) – In his study on developed a GIS-integrated decision support model to identify optimal sites and decision suitable recharge structures for enhancing groundwater recharge.
- Johnson et al. (2019) – Johnson study on selecting appropriate recharge structures. Enhancing ground water recharge and water security.
- Lee et al. (2018) – in his study analyze data and create maps.
- Kumar et al. (2020) – Kumar identify potential sites for ground water recharge using GIS and RS techniques use
- Chen et al. (2021) – Chen studied using GIS to identify suitable sites for ground water recharge. Selecting appropriate recharge structures (e.g. pits, trenches, dams.)

III. Study area

Pandharpur, a city in Maharashtra's Solapur district, is a significant pilgrimage center and study area for researchers. Located on the banks of the Bhima River, also known as Chandrabhaga, Pandharpur is home to the revered Lord Vitthal temple, attracting millions of devotees annually. Pandharpur lies between 17°32’05” to 17°56’79” N latitude and 75°00’56” to 75°35’45” E longitude, with an area of 25 sq km. The city's climate is characterized by hot summers and moderate winters.

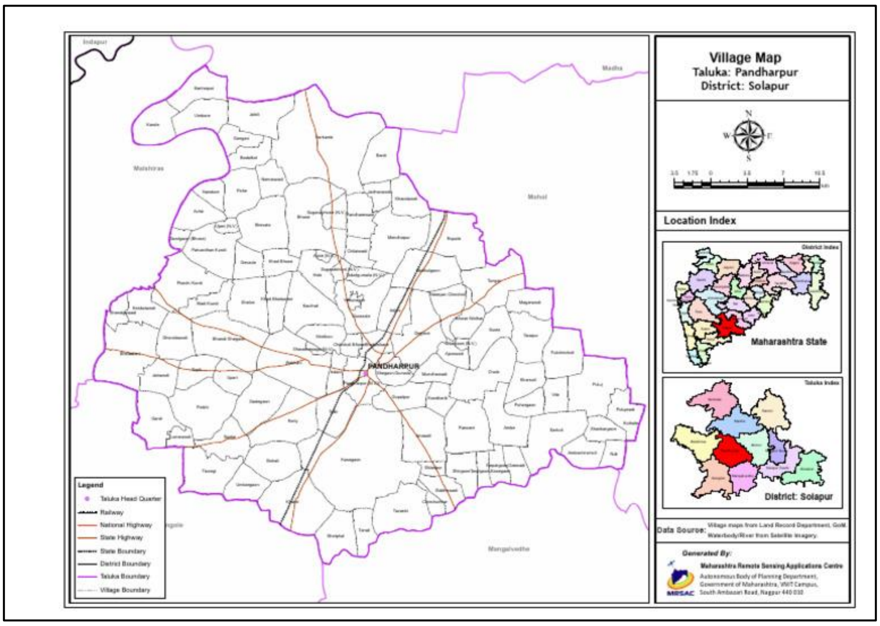

Fig. 1: Location map of Pandharpur

A. Material Used

- Rock
- Soil
- Water

B. Software

- GIS software
- Google earth pro
- QGIS
- TCX Converter

AREA	SIDE	TYPE OF SOIL
Padmavati lake	EAST	BLACK COTTON SOIL
Isbavi	WEST	BLACK COTTON SOIL
Pant Nagar	SOUTH	BLACK COTTON SOIL
Ahilya nagar	NORTH	BLACK COTTON SOIL

Table 1: Data Description

IV. METHODOLOGY

1) Data Collection: Gather data on terrain, soil, rock, land use, rainfall, and other relevant factors using, GPS, and field surveys.
2) GIS Mapping: Create detailed maps of the study area using GIS software, used for area selecting.
3) Using software for layers, contour map includes the software (Google earth pro, QGIS, TCX Convertor)
4) Taking soil sample and rock for testing for water absorption.

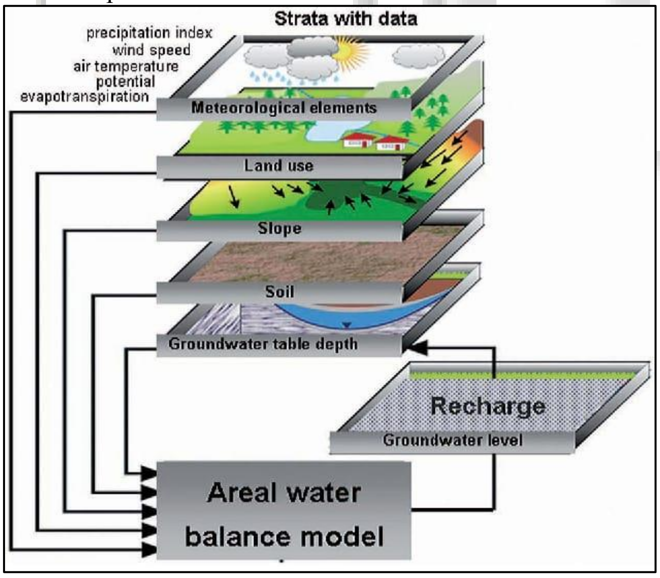

Fig. 2: Methodology

V. RESULTS AND DISCUSSION

The GIS-based model helps identify the best locations for groundwater recharge by analyzing layers like land use, soil, slope, rainfall, and groundwater depth. Using weighted overlay analysis, the area is classified into suitable and unsuitable zones, and appropriate structures such as check dams, percolation tanks, and recharge pits are suggested. The final result provides a clear recharge suitability map that supports effective planning and sustainable groundwater management.

A. Geology

The following map provided is a detailed geological map of the Pandharpur area, located in parts of the pandharpur districts of solapur, India. The map uses an index to differentiate various lithological units, including alluvium (yellow), gabbro (dark green), anorthosite (light green), ultramafic such as pyroxenite/hornblendite (darker green with diagonal lines), and magnetite bodies/lenses (black shapes). Structural features like vertical foliation, foliation with dip angles, vertical joints, and joints with dip angles are indicated by standard geological symbols. Key localities such as Pandharpur, Adamapur and Azad Basti are also marked on the map, along with a scale in kilometers and grid references for latitude and longitude.

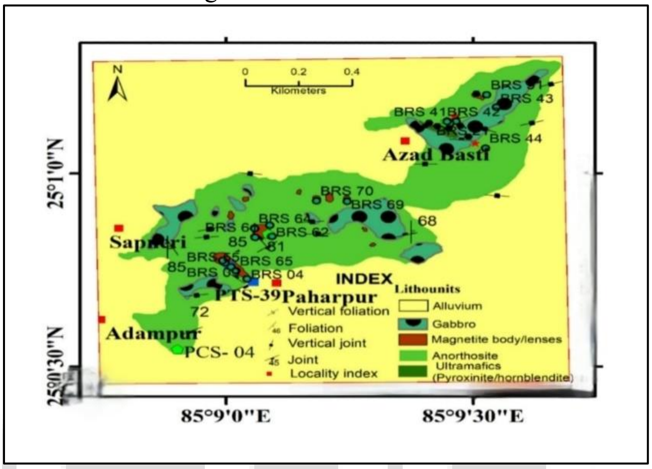

Fig. 3: Geology map

B. Contour map

In Pandharpur, Maharashtra, a contour map like the one shown highlights the area's topography using red lines representing elevation contours. These contours help visualize the terrain's shape and elevation changes. Pandharpur, located on the Bhima River banks, is known for the revered Lord Vitthal temple. Contour maps like this are useful for understanding landforms, planning water resource management like groundwater recharge, and assessing terrain suitability for various activities.

Fig. 4: Contour map

C. Ground Water Contour

The map you've shared doesn't seem to represent Pandharpur, Maharashtra directly. The image shows a topographic map with yellow as the base color, blue lines indicating water bodies (likely rivers or streams), and black lines marking boundaries (maybe district or administrative borders).

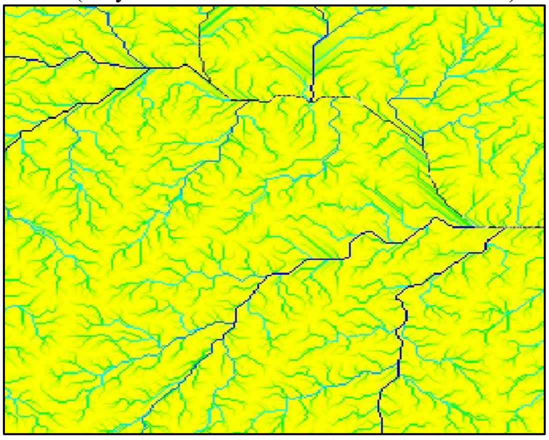

Fig. 5: ground water contour map

D. Land flow view

Pixelated and in grayscale, showing some texture that looks like rocky or uneven terrain with a dark outline of a shape on top.

In Pandharpur, Maharashtra, land flow or drainage patterns typically depend on the local topography and water sources like rivers or streams. Pandharpur is known for the Bhima River (also called the Chandra Bhaga River) and is a significant pilgrimage site due to the Vitthal Temple

Fig. 6: Land flow view

E. Soil sample & rock sample

Sr no	Side	Location	Wet (weight)	Dry (Weight)	Percentage
1	East	Padmavati lack	1.480 kg	0.850 gm	42.56 %
2	West	Isbavi	1.558 kg	0.962 gm	38.25 %
3	South	Panth nagar	1.674 kg	0.870 gm	48.02 %
4	North	Ahilya nagar	1.608 kg	0.932 gm	42.03 %

Table 2: Weightage and ranking for soil

Sr no	Side	Location	Wet (weight)	Dry (Weight)	Percentage
1	East	Pdmavati lack	1.480 kg	0.974 gm	3.94 %
2	West	Isbavi	1.558 kg	0.990 gm	7.47 %
3	South	Panth nagar	1.674 kg	0.996 gm	2.16 %
4	North	Ahilya nagar	1.608 kg	0.992 gm	1.97 %

Table 3: Weightage and Ranking for Rock

VI. CONCLUSION:

New techniques in road water percolation, such as permeable pavements, GIS mapping, and advanced modeling tools, offer promising solutions for sustainable water management. By harnessing these innovations, we can reduce stormwater runoff, recharge groundwater aquifers, and minimize urban flooding. Effective implementation of these techniques can enhance road safety, support ecosystem services, and contribute to more resilient and sustainable urban environments. As we continue to develop and refine these technologies, we can create better infrastructure that benefits both our communities and the environment.

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